Docket No.: H0498.70112US01
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Charles M. Lieber et al.
Serial No.:	10/812,653
Confirmation No.:	3416
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For:	NANOSCOPIC WIRE-BASED DEVICES AND ARRAYS
Examiner:	H. Weiss
Art Unit:	2814

DECLARATION

I, Professor Charles Lieber, declare that:

1. I am the Mark Hyman Professor of Chemistry in the Department of Chemistry and Chemical Biology and the Division of Engineering and Applied Sciences at Harvard University. I have been a professor at Harvard University since 1991, and I have received numerous awards, including the Nanotech Briefs Nano 50 Award (2005), the Scientific American 50 Award in Nanotechnology and Molecular Electronics (2003); the New York Intellectual Property Law Association Inventor of the Year (2003); the APS McGroddy Prize for New Materials (2003); the Feynman Prize in Nanotechnology (2001); the NSF Creativity Award (1996) and the ACS Award in Pure Chemistry (1992). I am an elected member of the National Academy of Sciences and the American Academy of Arts and Sciences, Fellow of the Materials Research Society, American Physical Society, Institute of Physics and American Association for the Advancement of Science.

2. I am an inventor of U.S. Pat. Apl. Ser. No. 10/812,653 (the "Patent Application"). I have read and understood the specification of the Patent Application, the pending claims, and the office action issued on January 2, 2009 (the "Office Action"), including Melzner, *et al.*, U.S. Patent No. 5,774,414 ("Melzner") and Brandes, *et al.*, U.S. Patent No. 6,445,006 ("Brandes").

3. I have a financial interest in the issuance of this application as a patent via at least the following. A portion of any royalties derived from licensing of the intellectual property represented by this patent application will flow to me.

4. Melzner discloses a memory device that includes a plurality of memory cells each containing a micromechanical diaphragm under compressive stress (Col. 1, lines 49-61). Each memory cell is mechanically bistable, as the diaphragm seeks to reduce compressive stress by bending, either upward or downward. The two bistable states are mechanically stable, and can be converted from one state to the other by the exertion of a force, such as a pneumatic (gas) force or an electric force (Col. 2, lines 39-46; Col. 2, line 60-Col. 3, line 8). The diaphragm is typically formed from silicon (Col. 12, lines 12-38). The status of the memory cell, i.e., whether the diaphragm is bent upward or downward, is determined by determining electrical contact of

the diaphragm with a point (item 10 in Fig. 2E) on a substrate positioned below the diaphragm (Col. 10, lines 21-44; Col. 11, lines 34-48).

5. Brandes discloses forming connections between objects such as electrodes with nanotubes, and devices made in this way. Brandes does not disclose or in any way suggest that nanotubes used in his techniques or devices are exposed to any compressive forces, or that they would be expected to be able to do so and that this would facilitate use of these nanotubes in any sort of electronic device. Brandes suggests that nanotubes that can move by applying a deflecting force on a nanotube fixed at one end (see, Col. 9, line 4-Col. 10, lines 16). However, in each such embodiment, the nanotube is only fixed at one end. See, e.g., Figs. 11-13. Accordingly, the nanotubes are not under any compressive stress during movement, since one end of the nanotubes is free to move. Indeed, the devices disclosed in Brandes (e.g., a flow sensor, an accelerometer, a ciliated motive driver, and a microelectromechanical relay) would each fail to operate if the nanotube was under compressive stress, as the nanotube would not be free to move in each case. Accordingly, Brandes does not disclose a carbon nanotube under compressive stress in any stage of use of a device he discloses.

6. Brandes also discloses that nanotubes can be made to grow in a variety of directions using an applied electric field (Col. 5, line 30-Col. 6, line 45) but, in such embodiments, Brandes nowhere contemplates that such nanotubes would be mobile; to the contrary, Brandes discloses "spot welding" the ends of the nanotube onto a surface after formation (see, e.g., Col. 6, lines 32-39), and nowhere suggests that after attachment of both ends in this way the nanotubes can or should move (including experiencing any compressive stress) during use.

7. Accordingly, Brandes would not in any way be suggested for combination with Melzner as suggested by the Office Action, as Melzner will not operate without a diaphragm under compressive stress, while Brandes nowhere suggests that carbon nanotubes would experience compressive stresses in a way such that they could substitute for the diaphragms of Melzner. Furthermore, Brandes nowhere suggests that carbon nanotubes, other than those fixed at only one end, are able to move or would in any way be movable for use in a device such as that of Melzner. Indeed, Brandes teaches away from Melzner since the carbon nanotube devices in Brandes are not taught for operation under compressive stress or other such movement.

8. Moreover, a nanotube likely could not be adapted to form a device as disclosed in Melzner. If the circular diaphragm in Melzner were replaced with a nanotube, then alignment of the nanotube with a single contact point (10 in Fig. 2E of Melzner) would be difficult, if not impossible. An error of even a few nanometers in alignment would result in a nonfunctional device. Melzner solves the problem of alignment by using circular diaphragms, which not only provides the mechanical bistability discussed above, but increases the potential area of contact.

9. Even if one were to consider combining of Melzner and Brandes, without the benefit of the disclosure of the Patent Application, one would not predict that an arrangement as disclosed in the Patent Application and as recited in the pending claims would result. In fact, one would predict that such an arrangement would not work. One would expect that substituting the diaphragm-containing conductors of Melzner with nanotubes (as disclosed by Brandes or otherwise), and forming a crossed-conductor array with at least one set of conductors defined by

nanotubes, would result in a non-functional device. One would expect that simply applying opposite potentials to a first conductor (wire or nanotube) and a nanotube crossing the first conductor, might at best slightly deflect the nanotube, but would not be sufficient to repeatedly connect and disconnect the first conductor and nanotube. And even if one were to assume that connection/disconnection would be possible in this way, one would not predict that both a "connected" and "disconnected" state of the first conductor and nanotube would each be stable, i.e., that one could apply opposite charge to the two to connect the two, remove application of opposite charge and realize continued connection of the two, then apply like charge to disconnect the two, and remove application of like charge and realize continued disconnection of the two. The ability to connect and disconnect the first conductor and nanotube, without auxiliary means other than the electrical connections also used to "read" the connected or disconnected states, and especially the bistability of the system, was not predicted by me to work when first contemplated, and its success in function was a great surprise to me.

10. All statements made herein of my own knowledge are true and all statements made on information and belief are believed to be true; and further, these statements were made with knowledge that willful false statements and the like are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code, and that any such willful false statements may jeopardize the validity of this application or any patent issued thereon.

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